Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – September 2013

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Overview

This update is a summary of activities since the previous status report of September 2013 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b; USFWS 2009; USFWS 2010a, b; USFWS 2012a; USFWS 2012b; USFWS 2013).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006-September 2013 are posted on the Technical Oversight Committee's web site at http://www.sfwmd.gov/toc/. This report includes information from samples collected through September 2012.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (July – September 2013)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 29 stations in July, 26 in August, and 31 in September 2013 (**Table 1**).

Total phosphorus data available to date for October 2012 through September 2013 are presented in **Table 1**. Maps of stations where samples were collected for the months from July through September 2013 are presented in **Figures 2-4**.

Conductivity sonde deployment information for October 2012 through September 2013 is presented in **Table 2**.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

USFWS. (2010a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 5th Annual Report – September 2010. LOXA08-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 43 pp.

USFWS. (2010b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 6th Annual Report – October 2010. LOXA09-011, U.S. Fish and Wildlife Service, Boynton Beach, FL. 42 pp.

USFWS. (2012a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 7th Annual Report – February 2012. LOXA12-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 115 pp.

USFWS. (2012b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – October 2012. LOXA12-004, U.S. Fish and Wildlife Service, Boynton Beach, FL. 68 pp.

USFWS. (2013) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – June 2013. LOXA13-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

Table 1. Total phosphorus data (ppb) available for October 2012 – September 2013 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
LOXA101	26	32	20	23	19	21	-	14	179	21	18	15
LOXA102	12	11	13	11	10	6	-	-	16	-	-	15
LOXA103	13	8	11	8	6	-	-	-	21	-	-	11
LOXA105	41	14	18	20	17	13	-	9	153	15	-	21
LOXA106	13	10	13	9	8	6	-	-	19	6	-	23
LOXA107	10	7	13	8	-	-	-	-	12	-	-	-
LOXA108	8	5	5	6	-	-	-	-	10	5	7	7
LOXA109	11	7	10	7	6	6	8	7	13	6	10	15
LOXA110	8	7	9	10	12	8	7	5	8	5	6	6
LOXA111	9	7	6	5	4	3	7	4	8	5	6	6
LOXA112	11	8	8	6	6	6	5	6	17	6	9	9
LOXA113	7	6	3	12	U	5	10	5	7	4	6	5
LOXA114	7	6	4	8	3	7	8	6	24	4	7	6
LOXA117	30	19	16	14	8	6	12	7	16	10	10	14
LOXA118	10	8	8	9	9	3	6	6	9	5	7	8
LOXA119	9	8	5	7	5	6	9	8	7	5	8	9
LOXA120	7	7	5	8	4	7	4	5	6	5	8	8
LOXA122	22	12	18	13	9	6	13	8	11	7	10	13
LOXA124	23	17	17	19	11	12	-	7	185	10	13	25
LOXA126	12	6	6	12	4	4	U	4	13	14	10	7
LOXA127	9	8	4	7	4	7	6	5	3	5	10	7
LOXA128	8	6	4	7	6	8	-	4	6	5	7	5
LOXA130	18	8	11	9	13	5	5	5	22	6	8	10
LOXA131	13	6	6	6	4	4	4	7	9	6	8	10
LOXA133	28	15	17	16	26	9	-	-	29	11	-	23
LOXA134	22	8	9	10	8	5	4	7	14	6	7	10
LOXA136	26	15	64	17	26	10	-	14	21	10	12	14
LOXA137	17	10	13	12	10	6	7	8	14	5	8	11
LOXA138	12	7	7	17	8	7	4	7	12	4	7	9
LOXA139	15	7	7	4	11	7	-	6	9	5	6	5
LOXA140	12	10	12	14	10	7	-	5	27	6	8	10
LOXA141	11	11	14	14	9	11	11	11	9	7	12	10
MAX	41	32	64	23	26	21	13	14	185	21	18	25
MIN	7	5	3	4	3	3	4	4	3	4	6	5

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
LOXA104	40	24	49	28	24	26	28	38	270	32	32	36
LOXA115	37	27	19	19	13	19	20	47	83	26	25	32
LOXA129	31	24	33	24	26	20	31	45	54	27	32	40
LOXA132	30	26	28	23	18	23	26	41	55	26	34	40
LOXA135	30	30	25	23	20	21	26	60	58	29	38	39
MAX	40	30	49	28	26	26	31	60	270	32	38	40
MIN	30	24	19	19	13	19	20	38	54	26	25	32

Table 2. October 2012 – September 2013 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1. Stations labeled DECOM were decommissioned.

	2012			2013								
Site ID	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LOXA104	X	X	X	X	X	X	X	X		X	X	X
LOXA105	X		X		X		X		X		X	
LOXA106	X		X		X		X		X		X	
LOXA107	X		X		X		X		X		X	
LOXA108	X		X		X		X		X		X	
LOXA111		X		X		X		X	DECOM-->			
LOXA112		X		X		X		X	DECOM-->			
LOXA113		X		X		X		X	DECOM-->			
LOXA114		X		X		X		X	DECOM-->			
LOXA115	X	X	X	X	X	X	X	X		X	X	X
LOXA116		X		X	X		X		X		X	
LOXA117		X		X	X		X		X		X	
LOXA118		X		X	X		X		X		X	
LOXA119		X		X	X		X		X		X	
LOXA120		X		X	X		X		X		X	
LOXA126		X		X		X		X	DECOM-->			
LOXA127		X		X		X		X	DECOM-->			
LOXA128		X							DECOM-->			
LOXA129	X	X	X	X	X	X	X	X		X	X	X
LOXA130	X		X		X		X		X		X	
LOXA131	X		X		X		X		X		X	
LOXA132	X	X	X	X	X	X	X	X		X	X	X
LOXA133	X		X		X		X		X		X	
LOXA135	X	X	X	X	X	X	X	X		X	X	X
LOXA136	X		X		X		X		X		X	
LOXA137	X		X		X		X		X		X	
LOXA138	X		X		X		X		X		X	
LOXA139	X		X		X		X		X		X	
LOXA142	X	X	X		X	X	X	X		X	X	X
LOXA143	X		X				X		X		X	
LOXA144	X		X		X		X		X		X	
LOXA145	X		X		X		X		X		X	
LOXA146	X		X		X		X		X		X	
LOXA147	X	X	X	X	X	X	X	X	X	X	X	X
LOXA148	X		X		X		X		X		X	
LOXA149	X		X		X		X		X		X	
LOXA150	X		X		X		X		X		X	
LOXA151	X	X	X	X	X	X	X	X		X	X	X
LOXA152	X	X	X	X	X	X	X	X		X	X	X
LOXA153	X	X	X	X	X	X	X	X		X	X	X
I-8C	X	X		X	X		X	X	X	X	X	X
LOX04	X		X		X		X		X		X	
LOX06		X		X		X		X	DECOM-->			
LOX07		X		X		X		X	DECOM-->			
LOX08		X		X		X		X	DECOM-->			
LOX09		X		X		X		X	DECOM-->			
LOX10		X		X		X		X	DECOM-->			
LOX15	X		X		X		X		X		X	

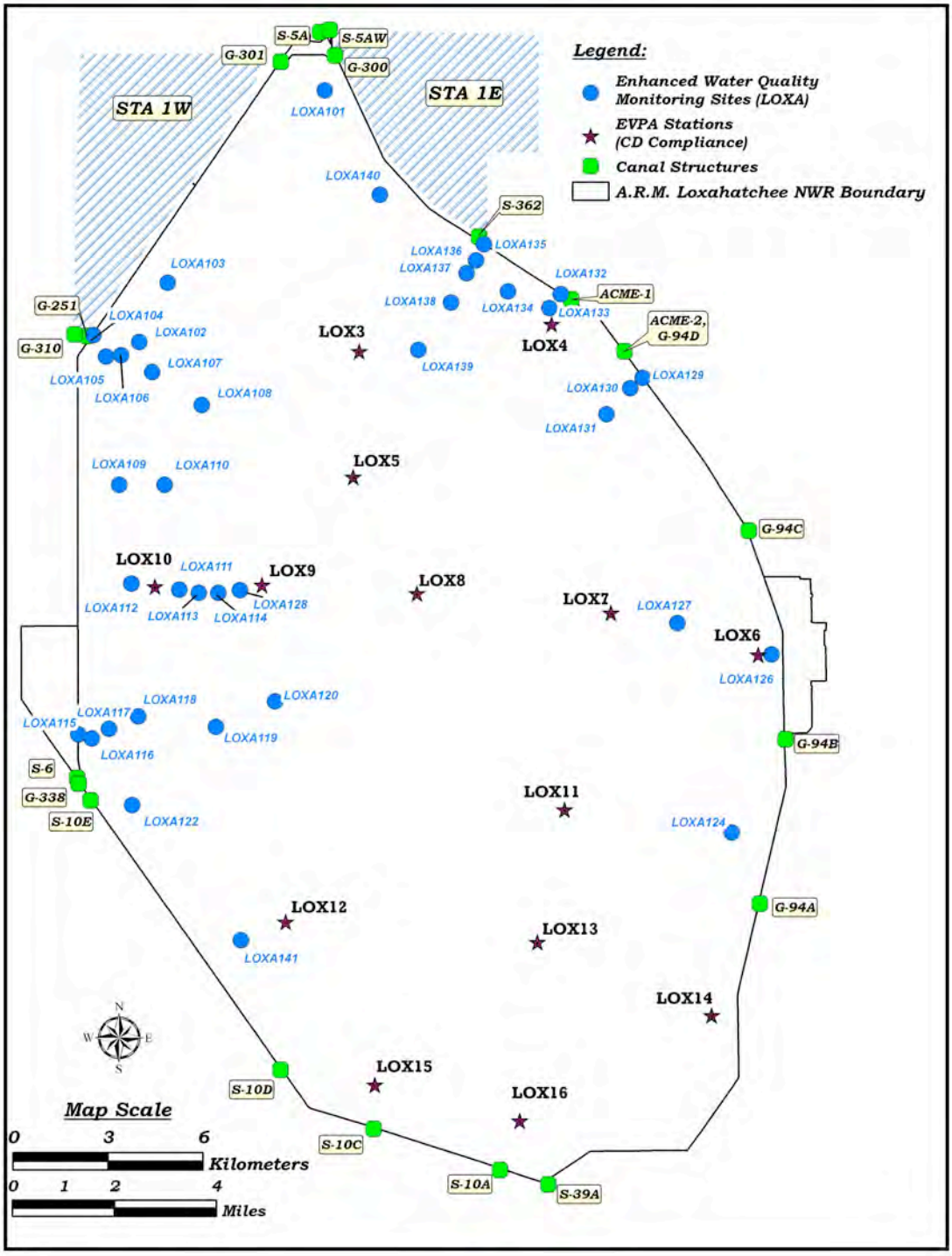

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

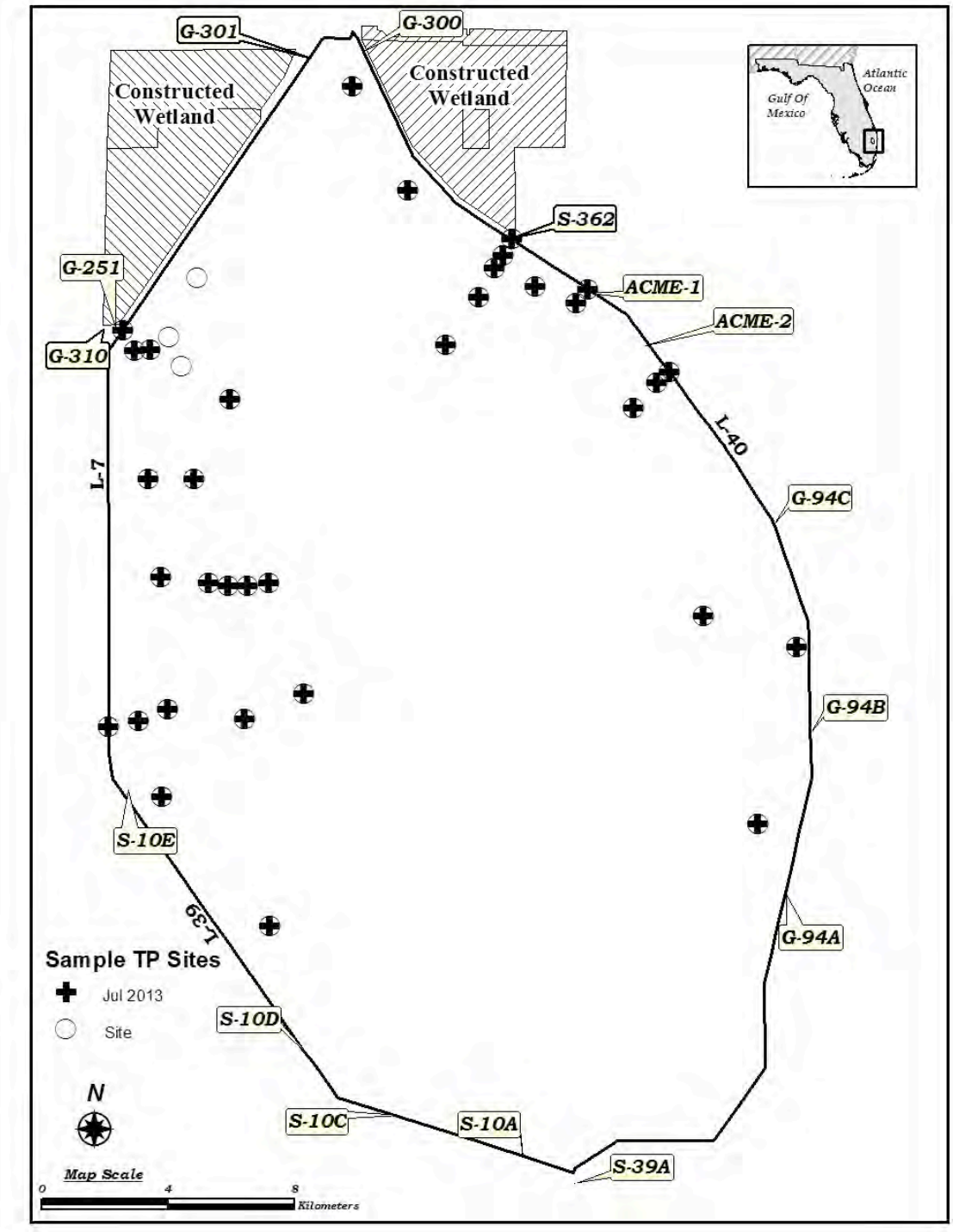

Figure 2. July 2013 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

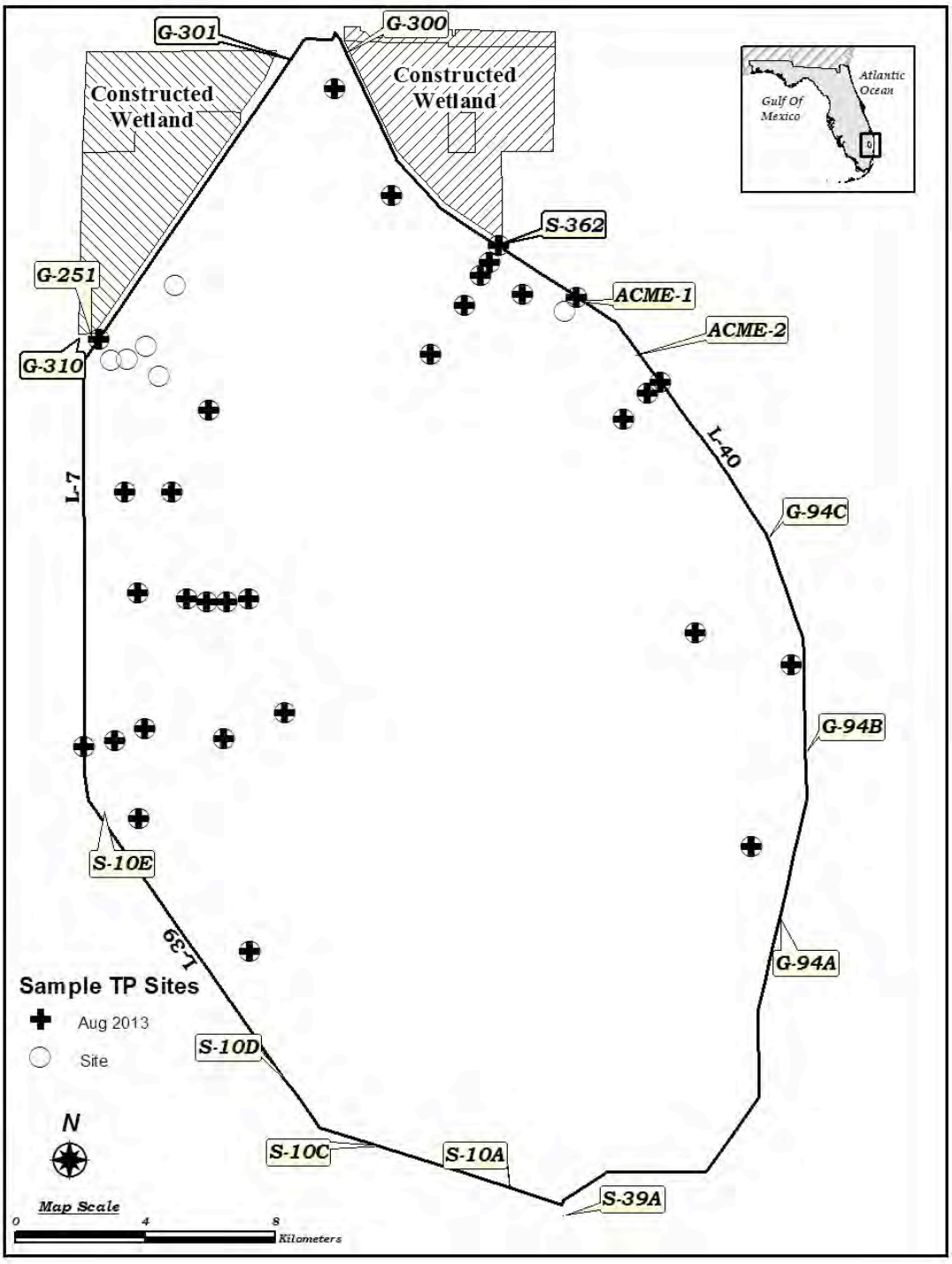

Figure 3. August 2013 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

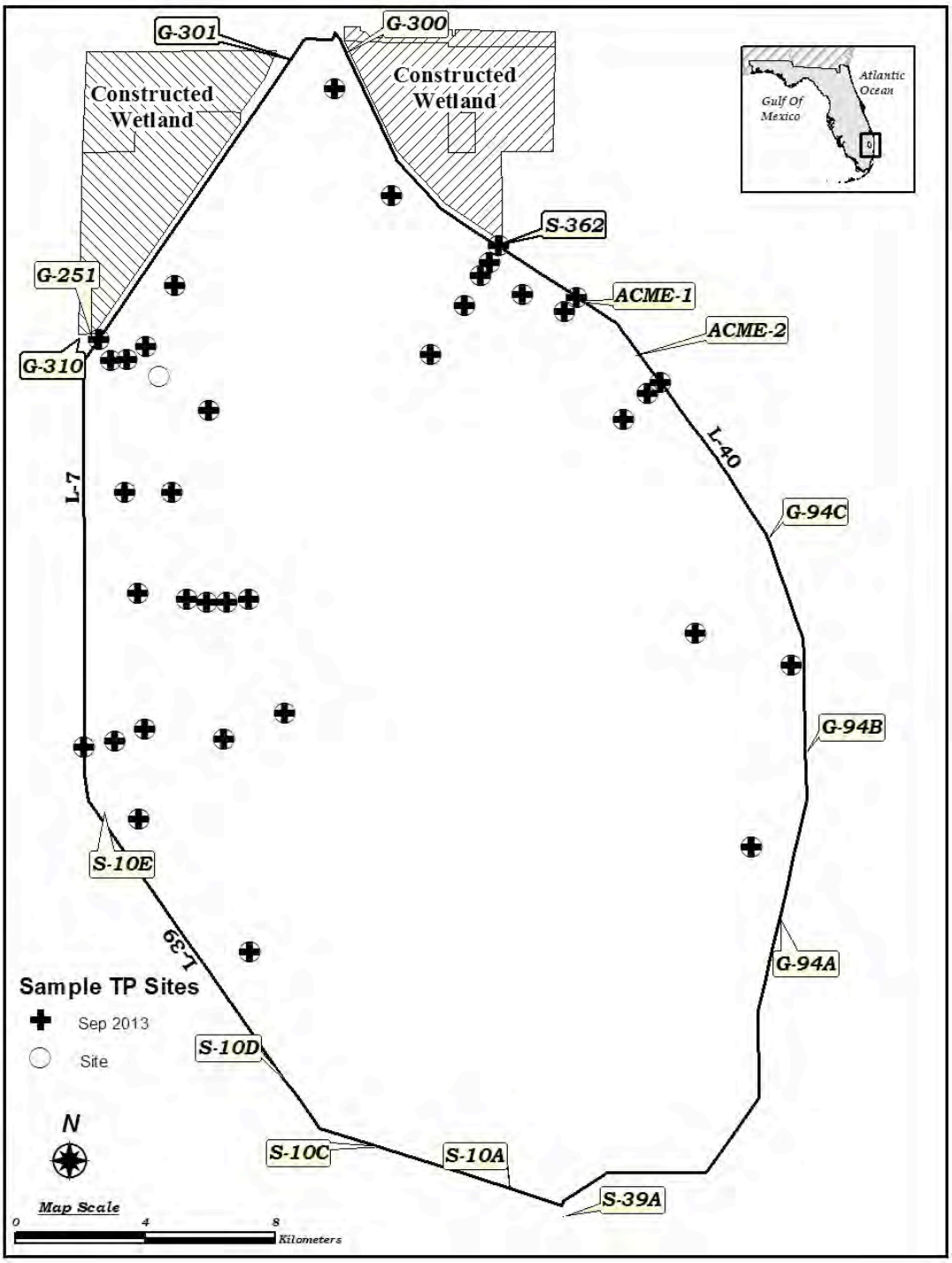

Figure 4. September 2013 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.